

REMARKS

Claims 24, 26-29, and 31-33 are pending in this application. Claims 24, 2831 are the independent claims. No claims are amended. Claims 1-23, 26, and 30 were previously cancelled. Reconsideration and allowance of the present application are respectfully requested.

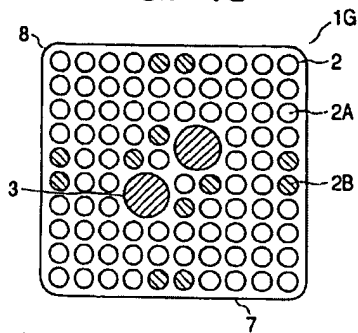
Rejections under 35 U.S.C. §103 – Orii in view of Ueda and Johansson

Claims 24 and 26-29 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent 6,735,267 (“Orii”) in view of U.S. Patent 5,068,082 (“Ueda”) in view of U.S. Patent 5,229,068 (“Johansson”). This rejection is respectfully traversed.

The Examiner rejects claims 24 and 26-29 as being unpatentable over Orii et al. (“Orii”) in view of Ueda et al. (“Ueda”) and further in view of Johansson et al. (“Johansson”). The Examiner asserts that Orii teaches the basic inventive concept of independent claims 24 and 28 including a generally square fuel bundle having a pair of water passages with circular cross-sections located centrally or proximal center, a first part-length rod group including two pair of part-length fuel rod subsets in a mirror-image along the centerline located between the two water passages and a second part-length rod group including four pair of part-length rods located in the outermost rows of a 10x10 matrix adjacent to one of the four sides of the tube. The Examiner relies on FIG. 15 (see figure below) of Orii, to make this assertion¹.

¹ See page 4, of the December 20, 2006 Office Action.

FIG. 15



The Examiner cites Ueda, FIG. 19 (see figure below) and col. 12, lines 53-66, asserting that Ueda indicates that it is well-known in the art to provide certain groupings of part-length rods, and in particular 3-rod subgroups adjacent to a water passage². The Examiner cites col. 2, lines 3-15 of Johansson³, asserting that Johansson teaches that the addition of part length rods lowers the pressure drop and thereby improves the critical power of a fuel bundle. Also, the Examiner asserts that the inclusion of a third rod in Orii is no more than the duplication of parts with predictable and intended effects, such that a skilled artisan wishing to duplicate the effect of one of the part-length rods in a 2-rod subgroup.

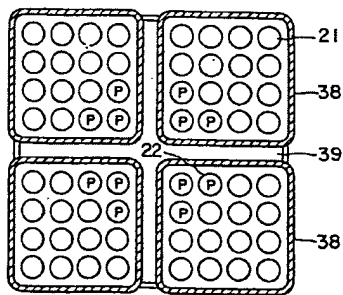


FIG. 19

² See page 4, of the December 20, 2006 Office Action.

³ See page 6, of the December 20, 2006 Office Action.

With regard to Orii, Applicant submits that Orii discloses specific conditional Equations (see Equations 1-6, as listed in the Abstract) that are used to determine acceptable orientations for full-length and part-length rod patterns in a fuel assembly. The primary objective of Orii's conditional Equations is to provide rod patterns that increase burn-up without increasing pressure loss, as stated in at least column 1, lines 54-58. Orii's conditional Equations involve several parameters including total horizontal sectional area of water rods (A_{wr}), horizontal sectional area of a coolant flow passage in a bottom portion of the fuel assembly (A_{ch}), effective fuel length of the full-length fuel rods (L_f), effective fuel length of the part-length fuel rods (L_p), number of part-length rods (n), and average burn-up (GWd/t), which are used to arrive at acceptable fuel rod orientations. Orii uses Equations 1-6 as a starting point, and includes additional conditional Equations that are specific to each of 6 distinct embodiments disclosed by Orii. The 6 distinct embodiments are summarized, below.

- Embodiment 1: Pertaining to FIGS. 2 and 8.
- Embodiment 2: Pertaining to FIGS. 9 and 11.
- Embodiment 3: Pertaining to FIGS. 12 and 14.
- Embodiment 4: Pertaining to FIGS. 15 and 17.
- Embodiment 5: Pertaining to FIGS. 18 and 20.
- Embodiment 6: Pertaining to FIGS. 21 and 23.

The Examiner concedes⁴ that Orii does not teach part-length rod groups that include two groups of "three part-length fuel rods in triangular orientation with one rod of the subset closer to the longitudinal centerline between the two water passages than the other two rods of the subset," as recited in independent claim 24. The Examiner asserts that it would have been obvious for a person of ordinary skill in the art to modify the fuel rod orientation of FIG. 15 of Orii ("embodiment 4" of Orii) by

⁴ See page 4 of the December 20, 2006 Office Action.

adding additional part-length rods, thus providing 3-rod groups of part-length fuel rods as disclosed in Ueda.⁵ Applicant asserts that Orii's specific fuel rod patterns, shown in FIGS. 2-23, were discovered through the rigorous application of Orii's conditional Equations, and **significant calculations and additional experimentation would be required to further modify Orii's fuel rod patterns while ensuring that Orii's Equations remain satisfied.** Specifically with regard to "Embodiment 4", column 13, line 49 through column 14, line 16 of Orii describes considerations that were included in arriving at the fuel rod patterns shown in FIGS. 15 and 17. Some of these considerations are provided below.

"By arranging the short length fuel rods 2B in the outer-most tier, the void coefficient is reduced to more than one half as small as that in the case where the short length fuel rods 2B are arranged in the second tier of the fuel rod array from the outer side."⁶

"However, in the case where the short length fuel rods 2B are arranged at the corners of the outermost tier, both of the reactivity loss and the local power peaking factor of the short length fuel rods arranged at the corners become large. Therefore, arranging of the short length fuel rods 2B at the corners should be avoided."⁷

"Further, by arranging the short length fuel rods at the positions in the outermost tier... the reactivity loss and the local power peaking can be reduced."⁸

Applicant submits that Orii's "Embodiment 4" calculations (involving conditional Equations 1, 3, 4, 6, 11, and 15) culminate in the graphical representation shown in FIG. 16, where the "hatched" area of the figure represents acceptable fuel rod patterns that meet each of Orii's conditional Equations. FIGS. 15 and 17 represent two specific "Embodiment 4" fuel rod patterns that reside within the

⁵ See Pages 4 and 5 of the December 20, 2006 Office Action.

⁶ See column 13, lines 49-53 of Orii.

⁷ See column 13, lines 55-61.

⁸ See column 13, line 63 through column 14, line 2.

“hatched” area of FIG. 16. Applicant asserts that **the Examiner’s suggested modification of FIG. 15 improperly replaces rigorous calculations using Orii’s conditional Equations with mere speculation as to how the specifically derived fuel rod pattern of FIG. 15 may be further modified.** Applicant asserts that Orii’s FIG. 15 embodiment appears to be similar to the fuel rod pattern recited in independent claim 24 by a product of nothing more than coincidence, as Orii’s conditional Equations are only focused on increasing burn-up without increasing pressure loss. Applicant asserts that Orii does not teach or suggest a part-length rod pattern for improving reactor shutdown margin, and the Examiner points to no portion of Orii that discusses this attribute. Therefore, Applicant asserts that it would not have been obvious for a person of ordinary skill in the art to have modified the derived fuel rod pattern of FIG. 15 of Orii in the manner asserted by the Examiner.

With respect to Ueda, the Examiner’s citation to FIG. 19 and col. 12, lines 53-66 of Ueda⁹ is simply a general reference to 3-rod subgroups near water passages, where the 3-rod subgroups are full-length “interposed” rods (as shown in at least FIGS. 2A and 59A) filled with a significantly reduced level of fissile material in at least a portion of the fuel rod. As explained in the Abstract, Ueda also teaches embodiments using shorter-length rods (as shown for instance in FIGS. 21A, 22A, 25A and 57A). However, the specification and figures of Ueda indicate that the embodiment of FIG. 19 is an embodiment using full-length “interposed” rods 22, and not part-length rods (see description in col. 12, lines 53-66). While other embodiments such as FIG. 25A of Ueda do use part-length rods, the FIG. 19 embodiment is specific to only “interposed” rods. Therefore, FIG. 19 suggests no more

⁹ See page 4, of the December 20, 2006 Office Action.

than the use of full-length 3-group rods 22, consisting of fissile-material that differs from conventional rods, which may be located near a water passage. Further, the FIG. 19 water passage is cruciform-shaped, and not “a pair of circular-shaped water passages”, as recited in claim 24, making the relevance of FIG. 19 more attenuated. Additionally, the 3-rod groups in FIG. 19 are not “two subsets in a mirror-image relationship... between the two water passages”, as recited in claim 24, as they are instead four 3-rod subgroups. Lastly, Ueda’s FIG. 19 involves an 8x8 matrix, which differs from the “10x10 matrix” recited in Applicant’s claim 24. While the Examiner has explained that Ueda is not being cited in order to teach the precise part-length rod orientation of claim 24, Applicant asserts that the part-length rod orientation of FIG. 19 differs so significantly from claim 24 (with a very different water passage orientation, twice the number of 3-rod subgroups, and an 8x8 matrix as opposed to 10x10) that Ueda provides almost no guidance for a person of ordinary skill in the art to modify FIG. 15 of Orii. Furthermore, because FIG. 19 is teaching the use of full-length “interposed” rods, as opposed to part-length rods, it is Applicant’s belief that FIG. 19 is altogether inapplicable to claim 24 and the orientation of “part-length” rod groups.

The Examiner cites FIG. 25A of Ueda¹⁰ in order to support the assertion that Ueda teaches the use of 3-rod subgroups of part-length rods. While Applicant does agree that FIG. 25A discloses the use of part-length rods (unlike FIG. 19, which specifies only “interposed” rods), Applicant draws the Examiner’s attention to FIGS. 25B, 25C and 25D which are cross-sectional views at various elevations of FIG. 25A (as explained in col. 14, lines 41-46). It is clear from FIGS. 25B, 25C and 25D that the

¹⁰ See page 5 of the December 20, 2006 Office Action.

cruciform orientation of the 16 part-length rods depicted in FIGS. 25A – 25D provides no reasonable relevance to the teaching or suggestion of “three part-length fuel rod” subgroups, as recited in Applicant's claim 24.

Assuming, *arguendo*, that Orii could be combined with Ueda (Applicant does not admit or even believe that these references may be combined), the combination of these references would still not teach claim 24, as neither of these references teach “a first part-length rod group including two subsets in a mirror-image relationship along the centerline between the two water passages, each subset further comprising three part-length fuel rods in a triangular orientation with one rod of the subset closer to the longitudinal centerline between the two water passages than the other two rods of the subset,” as recited in claim 24.

Additionally, Applicant asserts that it is improper to combine Orii with Ueda. A combination of references that destroys the intended function of one of the references, is not proper¹¹. Orii places great weight on the satisfaction of conditional Equations to arrive at specifically derived part-length rod orientations that increase burn-up without increasing pressure loss. The combination of Orii with a reference that may suggest the use of 3-rod groups rather than 2-rod groups¹², or the combination of Orii with a reference that may suggest the benefits of part-length rods¹³, generally, is in essence destroying the specific teachings of Orii. Specifically, the Examiner relies on disregarding Orii's conditional Equations, and instead allowing for the mathematically derived Orii part-length rod orientations to be altered using only the very general

¹¹ *In re Gordon*, 733 F.2d 900, 902 (Fed. Cir. 1984).

¹² See the Examiner's assertion in introducing Ueda, on page 4 of the December 20, 2006 Office Action.

¹³ See the Examiner's assertion in introducing Johansson, on page 5 of the December 20, 2006 Office Action.

principles of Ueda. Applicant asserts that such casual manipulation of rigorously derived rod pattern orientations using only relaxed teachings would render the Orii reference inoperable for its intended purpose, and therefore the asserted combination of Orii and Ueda as stated by the Examiner is improper under 35 U.S.C. §103.

With respect to Johansson, the Examiner cites col. 2, lines 3-15 in making the assertion that Johansson teaches the addition of part-length rods which lower pressure drop and improve critical power¹⁴. Applicant asserts that the addition of Johansson's with the Orii and Ueda combination also causes Orii to be inoperable for its intended purpose. The Examiner's suggested combination of Johansson with Orii and Ueda would violate the conditional Equations of Orii. As such, combining Johansson with Orii and Ueda would destroy Orii for its intended purpose. This is an impermissible and non-obvious combination, and therefore claim 24 cannot be rendered obvious to a person of ordinary skill in the art.

Additionally, the Examiner appears to have used impermissible hindsight reconstruction to reject claim 24. By the Examiner's own admission, he is "not attempting to combine *every feature* of this embodiment with the primary reference, but rather has gleaned relevant teachings regarding the configuration and position of the 3-rod subgroup"¹⁵ in his explanation of the relevance of Ueda. The Examiner seems to have used Applicant's FIG. 2 as a blueprint, selected a prior art fuel assembly (Orii, FIG. 15) as the main structural device, and has then searched other prior art for the missing elements (two 3-rod subgroups near the water passages) without identifying or discussing a reasonable motivation to combine.

¹⁴ See Page 5 of the December 20, 2006 Office Action.

¹⁵ See page 8 and 9 of the December 20, 2006 Office Action.

The Federal Circuit has noted that the PTO and the courts "cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention," In re Fine, 837 F.2d 1071, 1075, 5 USPQ2d 1780, 1783 (Fed. Cir. 1988), and that the best defense against hindsight-based obviousness analysis is the rigorous application of the requirement for a showing of a teaching or motivation to combine the prior art references. Combining prior art references without evidence of such a suggestion, teaching, or motivation simply takes the inventor's disclosure as a blueprint for piecing together the prior art to defeat patentability--the essence of hindsight. Dembiczak, 50 USPQ2d at 1617.

In combining the teachings of Ueda and Johansson with Orii, the Examiner has argued that inclusion of a third part-length rod in the Orii configuration is "no more than the duplication of parts with predictable and intended effects."¹⁶ Applicant again draw the Examiner's attention to col. 13, lines 5-11 of Orii, which explain that the derived configuration of Orii's FIG. 15 embodiment satisfies Equations 1, 3, 4, 6, 11, and 15. As explained in col. 13, lines 43-45, the ratio of part-length rods to full-length rods is just one of the carefully selected attributes of FIG. 15. Orii continues, by explaining that the FIG. 15 embodiment may be in essence duplicated, with a similar embodiment as shown in FIG. 17 and discussed in col. 14, lines 7-16. Orii is clear that the precise positions of the part-length rods in FIG. 17, similar to FIG. 15, need to be arranged just as depicted in FIG. 17 (col. 14, lines 7-16). It should be noted that neither the specifically arranged part-length rod pattern of FIGS. 15, nor FIG. 17, teach Applicant's claim 24. Orii continues to teach other part-length rod orientations, for instance those shown in FIGS. 18 and 20 (and discussed in col. 14, lines 18-52

¹⁶ See page 4 of the December 20, 2006 Office Action.

and col. 15, lines 23-34), neither of which teach Applicant's claim 24. In each case discussed above, Orii specifies that the conditional Equations must be met in order to provide for the specific embodiments depicted in the figures. At no time does Orii suggest that other similar orientations involving part-length rods may be overtly manipulated or attempted, such that a skilled artisan would be motivated to openly experiment with placing more (or less) part-length rods within orientations already depicted within the provided figures. Orii places great emphasis on all rod orientations meeting the conditional Equations listed in the Abstract and discussed throughout the reference. For at least these reasons, it is apparent that simply adding (or subtracting) more part-length rods to Orii's FIG. 15 would not be merely duplicating parts with a predictable and intended effect, but instead would disrupt the specifically derived orientation of part-length rods that meet the particular conditional Equations taught by Orii.

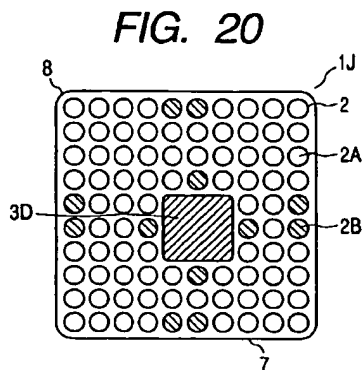
With regards to independent claim 28, the same arguments can be made against the cited art which does not teach either singly, or in combination, "two 3-rod subsets consisting of part-length rods in a mirror image relationship with one another along the longitudinal centerline between the two water passages, each 3-rod subset configured in a triangular orientation and directly adjacent to the pair of water passages".

For at least the reasons stated above, Applicant asserts that independent claims 24 and 28 are patentable. Due at least to the dependence of claims 26-27 and 29 on independent claims 24 and 28, Applicant asserts that these claims are also patentable. Therefore, Applicant respectfully requests that the art grounds of rejection of these claims under 35 U.S.C. § 103(a) be withdrawn.

Rejections under 35 U.S.C. §103 – Orii in view of Johansson

Claims 31-33 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Orii in view of Johansson. This rejection is respectfully traversed.

The Examiner rejects claims 31-33 as being unpatentable over Orii et al. (“Orii”) in view of Johansson et al. (“Johansson”). The Examiner points to Orii as the primary reference cited against these claims (see FIG. 20, below). The Examiner asserts that Johansson teaches that “the addition of part length rods lowers the pressure drop, thereby improving critical power,”¹⁷ which the Examiner explains provides the requisite motivation for a skilled artisan to modify Orii’s orientation such that two of the pairs of part-length rods near the tube sides may become lone part-length rods (rather than a pair of rods), and the four part-length rods on each side of the water passage may become two pairs, located on a corner of the water passage.



Applicant asserts that neither Orii or Johansson, either singly or in combination with each other, teach or suggest “a first rod group comprising two pairs of part-length rods arranged on either side of a corner of the square water-passage,

¹⁷ See page 5 of the December 20, 2006 Office Action.

and a second rod group comprising two pairs of part-length rods and at least two non-paired part-length rods, each of the two pairs and the at least two non-paired part-length rods located in a corresponding outermost row or column of the matrix adjacent a corresponding side of the tube," as recited in independent claim 31. Specifically, FIG. 20 of Orii does not teach two single part-length rods and two pairs of part-length rods along the sides of the tube, but rather, Orii teaches four pairs of part-length rods along the sides of the tube. Furthermore, FIG. 20 does not teach two pair of part-length rods each located near a corner of the water passage, but rather Orii teaches 4 separate part-length rods located equidistant along the 4 sides of the water passage. As stated explicitly in col. 15, lines 23-34, Orii arrives at the specifically derived part-length rod orientation of FIG. 20 (Orii explains in col. 15, lines 23-34 that this orientation is similar to the embodiment of FIG. 18) only by meeting the conditions of Equation 1, 4, 8, 10, 16 and 17 (see discussion in col. 14, lines 18-52, relating to FIG. 18). Therefore, Orii is not suggesting that the use of part-length rods is open to free movement of the part-length rod locations (or the addition or subtraction of part-length rods, generally), but rather, Orii is teaching the specific placement of these part-length rods as depicted in FIG. 18 and FIG. 20, based on the conditional Equations being met. Furthermore, Orii's main focus is to increase burn-up without increasing pressure drop, and therefore Orii does not teach or suggest the use of part-length rods to increase shut-down margin, for at least the reasons stated above related to claim 24.

The Examiner's suggested combination of Johansson with Orii would violate the conditional Equations of Orii. As such, combining Johansson with Orii would destroy Orii for its intended purpose. As discussed above with respect to claim 24, this is an

impermissible and non-obvious combination. Claim 31, therefore, cannot be rendered obvious to a person of ordinary skill in the art by combining Orii in view of Johansson.

For at least the reasons stated above related to independent claim 31, Applicant asserts that this claim is patentable. Due at least to the dependence of claims 32 and 33 on claim 31, Applicant also asserts that claims 32 and 33 are patentable. Therefore, Applicant respectfully requests that the art grounds of rejection of these claims under 35 U.S.C. § 103(a) be withdrawn.

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CONCLUSION

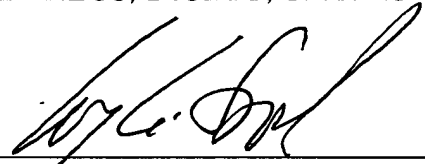
In view of the above remarks and amendments, Applicant respectfully submits that each of the rejections has been addressed and overcome, placing the present application in condition for allowance. A notice to that effect is respectfully requested. If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to contact the undersigned.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact the undersigned at the telephone number below.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 08-0750 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,
HARNESS, DICKEY, & PIERCE, P.L.C.

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